BENEFITS OF EXERCISE IN HEALTH AND DISEASE

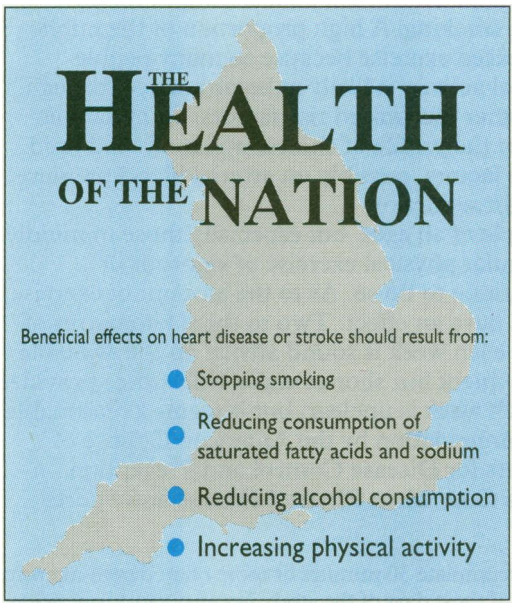
P H Fentem

Recommendations of the Royal College of Physicians

- There is now good evidence of many physical and psychological benefits available to the population from regular exercise which should be recognised by all those involved in health care
- The habit of taking regular recreational exercise is best started in childhood and should be continued into middle age and where possible into old age because exercise helps to make the most of diminishing physical capacity
- Doctors should ask about exercise when they see patients, particularly when they come for routine health checks, and should be aware of and advise on suitable exercise programmes
- The value of exercise for patients with a wide range of disorders should be considered and advice given on the type and extent of activity to be undertaken
- Doctors should be aware of the relevant risks that exercise may pose for individual patients. When exercise is of suitable intensity for the individual, is taken regularly and with sensible precautions, the benefits greatly outweigh any risks

The claim that individual participation in adequate amounts of regular physical activity can improve health and prevent disease is fully justified. The scientific evidence is based on many studies—epidemiological, clinical, and physiological. A working party of the Royal College of Physicians, convened in 1989, examined this evidence, recognised its importance, and based a series of recommendations on it.

Coronary heart disease and stroke are identified as key priorities in the white paper, *Health of the Nation*. In these two conditions individual risk is dramatically reduced by a change in lifestyle and an increase in physical activity. Other important benefits must not be overlooked. The list is extensive but falls into four categories: enhancing function, maintaining reserve capacities, preventing disease, and ameliorating the effects of age and chronic disease.



The task of achieving appropriate changes in lifestyle and of successfully promoting physical activity is formidable. Primary health care teams have been given an important role in implementing health promotion strategies. *Better Living—Better Life*, prepared by the Joint Working Group on Health Promotion and sent to all general practices last year, is an important resource. It contains the background, ideas for action, and advice about how to motivate patients and should prove indispensible for those contracting to undertake this work.

Recognition of the importance of the benefits conferred by regular physical activity has been slow to develop among those concerned with health care in the United Kingdom. According to the Allied Dunbar national fitness survey, three quarters of the general public (adults over 16 years of age) understand that exercise confers important health benefits but not what that means.

Functional changes and improvements achievable through exercise

Skeletal muscle functions enhanced by exercise

- Metabolic capacity and nutrient blood supply
  —Increases stamina
  —Ameliorates effects of age and chronic disease, including coronary heart disease
- Strength and contractility
  —Increases capacity for work and exercise
  —Reduces risk of injury
  —Ameliorates effects of muscle disease

The health benefits of exercise are explicable in terms of favourable physiological, psychological, and biochemical changes and improvements in function. Their scope is greater than has been supposed. Motivating sedentary people to pursue these benefits is not straightforward. They are reluctant to undertake even moderate exercise, and they become immediately aware of their limited tolerance for physical work and the discomfort that it provokes. It takes several weeks of regular exercise to see an improvement in their capacity for effort and for there to be a training effect.

Tendon and connective tissue functions enhanced by exercise

- Strength
- Supportive function
- Joint stability

—Reduces risk of injury especially with age and muscle disease

Joint functions enhanced by exercise

- Lubrication

—Avoids limitation of movement

- Range of movement

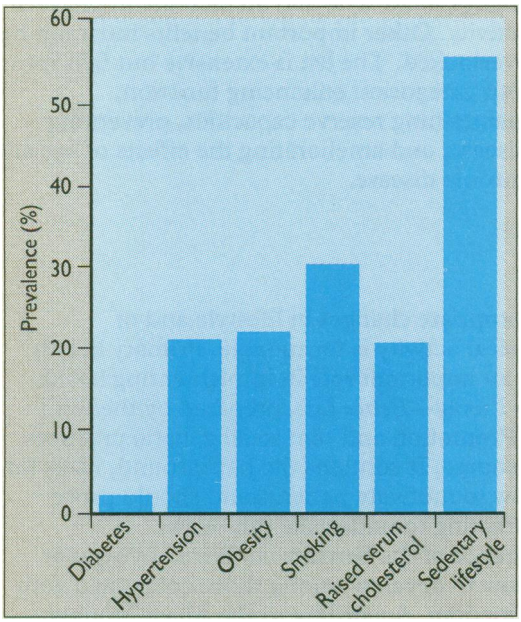
—Limits effects of degenerative arthritis

- Maintenance of flexibility

The objective should be to take enough regular exercise to improve or maintain stamina, to strengthen muscles, and to improve or maintain the range of joint movement. To improve stamina the effort needs to be somewhat greater than that to which the person is accustomed. This means that those who have previously been sedentary will show an improvement in some capacities even with a low intensity of exercise. The degree of improvement also depends on the duration and frequency of the activity. If an increased level of activity is sustained then the cumulative effects of training build up over many months. These decline again if the exercise is discontinued. Harmful effects are unlikely, provided that the intensity of exercise is increased gradually. A variety of activities is important because the changes induced in skeletal muscles by training, increased vascularity, and improved biochemistry are specific to the muscles used and how they are used. Guidelines for the safe prescription of exercise will be published later in the series.

After training people of any age can work harder, longer, and with less effort than previously: there is a reduced sense of effort for any given task. This is true for everyone and for all age groups including elderly people. A dose-response relation is apparent.

Prevention of coronary heart disease and stroke



Prevalence of risk factors for coronary heart disease and stroke. Sedentary lifestyle means no or irregular physical activity (fewer than three times a week or less than 20 minutes per session (less than level 2 of Allied Dunbar national fitness survey)).

Reducing the risk of heart attack and stroke

A sedentary lifestyle is an independent risk factor for coronary heart disease and stroke. High amounts of habitual physical activity reduce the individual risk for both conditions. The evidence derives from prospective and retrospective epidemiological studies. Fewer studies have been undertaken of the risk reduction of stroke, but the results lead to similar conclusions. The need for measures to raise the amount of habitual physical activity by the general public is as pressing as the need for ways to combat raised blood cholesterol concentration, raised arterial blood pressure, and smoking. A high proportion of the public stands to benefit from increased exercise because so many people currently take none. Physical activity is likely to be protective through a combination of effects on other recognised risk factors, on metabolic and regulatory processes, on the profile of cholesterol and blood lipid concentrations and clotting factors, possibly on arterial blood pressure, and through its role in weight reduction.

What matters is that people of all ages, but especially those in middle age, currently engage in regular physical exercise of vigorous or moderate intensity and continue to do so. As to the amount of exercise, brisk walking every day will have an effect. Two to three kilometres of brisk walking on three days each week is sound advice on the available evidence. Whether more frequent but shorter walks will suffice provided that the total is 8-16 km each week is unclear, but it seems a reasonable assumption. A recent recommendation by the American College of Sports Medicine, the Centers for Disease Control and Prevention (CDC), and the President's Council on Physical Fitness and Sports takes this approach saying:

> Every American adult should accumulate 30 minutes or more of moderate-intensity physical activity over the course of most days of the week. Because most Americans do not presently meet the standard described above, almost all should strive to increase their participation in moderate and/or vigorous physical activity.

This represents a definite shift in emphasis towards promoting physical activity of moderate rather than vigorous intensity and towards increased frequency of participation, at least five times a week rather than three times.

American recommendations

- Women to walk 2 miles in <30 minutes at least 3 days a week
- Men to walk 2 miles in <27 minutes at least 3 days a week
- Or 2 miles in 30-40 minutes 6 days a week
- Or a total of 2 miles (3 km) each day in 3 periods of 10 minutes

Prevention of mild or moderate systemic arterial hyptertension

High amounts of habitual exercise are a factor in determining the likelihood of arterial hypertension developing in previously healthy normotensive men and women.

Regular physical activity reduces both systolic and diastolic arterial blood pressure. Relatively small numbers of adults with mild or moderate or labile systemic arterial hypertension have been studied, but those who undertook regular physical activity experienced a reduction in arterial blood pressure of, on average, 10/8 mm Hg. This reduction is certainly therapeutically important but current opinion suggests that, for the time being, exercise should be considered an adjunct to other treatment.

Cardiovascular functions enhanced by exercise

- Cardiac performance/myocardial work
—Ameliorates the effects of age and chronic disease, including coronary heart disease
- Arterial blood pressure regulation
—Reduces blood pressure in mild hypertension and attenuates age dependent rise
- Electrical stability of heart muscle
- Cardiovascular and sympathoadrenal response to acute exercise
—Reduces risk of cardiac arrhythmias and probably of sudden death

Cardiac rehabilitation

One aim of rehabilitation must be to increase the patient's general capacity for physical work. A programme of regular exercise will achieve this improvement and by so doing will actually reduce the work which the heart must perform during physical effort. Thus regular exercise spares the heart by reducing the amount of work it has to perform. This comes about in two ways. Because the heart beats less frequently with improvement in aerobic fitness the energy requirement of the heart muscle is reduced. Because the systemic arterial blood pressure also falls this too reduces the workload on the heart muscle. As an extension of this, maximal myocardial performance is increased, allowing more exercise to be taken than before. Active cardiac rehabilitation is physiologically sound.

Current regular exercise has a significant place in secondary prevention of coronary heart disease and stroke. Despite some increase in the hazard for individual patients while they are exercising the benefits greatly outweigh these risks. Patients need not be advised against regular walking and exercise after stroke or heart attack, rather they should be encouraged and helped to increase the intensity of their exercise cautiously. Increments should be made every 8 or 10 weeks, provided that the patient complies with previous advice.

Prevention of sudden death in coronary heart disease

The risk factors for sudden death are similar to those for other manifestations of coronary heart disease. Thus it is not surprising that the general risk is moderated by regular exercise. The question of the risk of death or accident during a bout of exercise will, because of its importance, be considered in more detail later in the series.

Claims have not been substantiated that exercise leads to an increase in the diameter of coronary arteries, to formation of collateral vessels after a block or partial block of any of the three main coronary arteries, or to a decrease in the sensitivity of coronary arteries to spasm.

Prevention of other diseases

Functions of skeleton enhanced by exercise

- Maintenance of bone mass
- Adjustment of structure to load
—Prevents osteoporosis and fractures

Osteoporosis

Weight bearing exercise prevents osteoporosis. Regular physical exercise is one of several possible strategies for combating osteoporosis and the consequential fractures of the hip, wrist, and vertebrae. Habitual physical activity maintains and increases the mineral content of the skeleton. The effect is apparent at every age.

Skeletal bone mass increases during childhood and adolescence. The greater the peak bone mineral density at the end of growth the longer it will take to reach the fracture threshold in later life. Active children and young adults have denser bones than children who take little exercise.

After adolescence the bone density plateaus and then, after the fourth decade, decreases. At any age bone density is higher in men than in women. The rate of decline in bone mass is similar in both middle aged men and women except that in women the rate of loss accelerates for several years immediately after the menopause. These differences are sufficient to explain why elderly women reach the fracture threshold more often.

Habitual physical activity with weight bearing will halt or reverse the decline in density at any age. Women of all ages from 20 to 80 who exercise at least three times each week have a higher bone density than those who are sedentary.

Metabolic functions enhanced by exercise

- Control of body weight
—Regulates energy balance
—Prevents obesity related disease and excessive weight gain
- Insulin sensitivity and carbohydrate tolerance
—Improves carbohydrate tolerance
—Ameliorates late onset diabetes
- Lipid and lipoprotein metabolism
—Prevent coronary heart disease and possibly stroke
- Inhibition of blood clotting processes
—Counters acute precipitants of cardiac arrest

Non-insulin dependent diabetes mellitus

Habitual physical activity prevents non-insulin dependent diabetes mellitus. Laboratory studies had shown that exercise can increase insulin sensitivity and improve glucose tolerance, which offers an explanation for the favourable effect of activity on the prevalence of this condition. These biochemical changes benefit obese people, especially those with non-insulin dependent diabetes.

Good metabolic control can still be achieved by young diabetic patients who participate in sport because exercise, even vigorous exercise, leads to a predictable reduction of the exogenous insulin requirement.

Psychological functions enhanced by exercise

- Mood
—Reduces mild anxiety and depression
- Self esteem
—Influences mood favourably
- Psychomotor development
—Contributes to the quality of care for those with learning difficulties
- Memory
—Can improve memory in elderly people
- Calmness
—Can ameliorate stress related conditions

Cancer

Several recent epidemiological studies have observed that physically active people are less likely than those who have a sedentary lifestyle to develop breast and colon cancer.

Minor mental illness

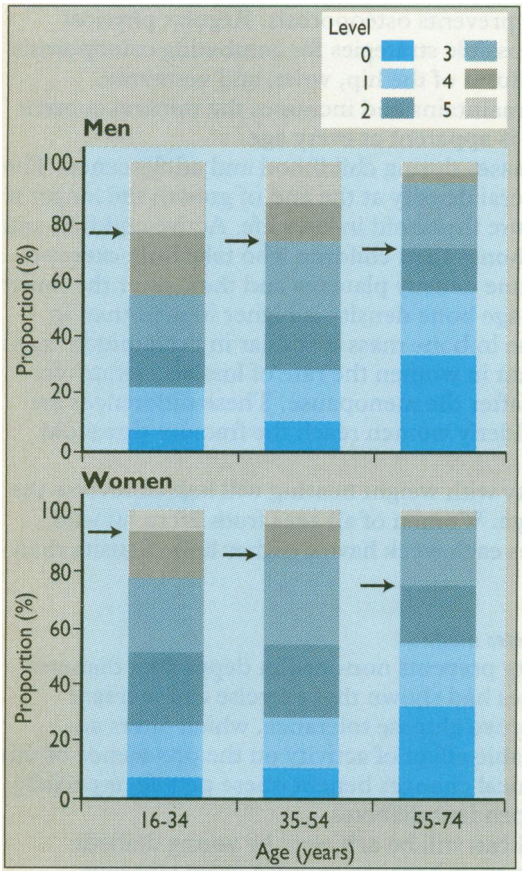
Improvements have been observed in patients with mild depression and anxiety, raising questions about its value as an adjunct to other measures in the management of minor mental illness. Because the physiological changes with regular exercise extend the range of activities that can be undertaken with confidence and ease, some of the psychological benefits are possibly linked to an improved general feeling of wellbeing. Other favourable effects have been noted.

Prevention of progressive incapacity

Assessing habitual physical activity: Allied Dunbar national fitness survey

Level*	No of occasions of type of activity
5	≥12, vigorous
4	≥12, mix of moderate and vigorous
3	≥12, moderate
2	5-11, at least moderate
1	1-4, at least moderate
0	None

*Based on 20 minute occasions of vigorous or moderate or mixed intensity.



Proportion of respondents in each of six levels of Allied Dunbar national fitness survey. Arrows show targets for people of different ages.

Physical inactivity as cause of avoidable disability

The prevalence of physical disability attributable to age or chronic disease is high. Inactivity compounds the effects of these disabilities; this needs to be recognised because inactivity is often reversible but not inevitable and is common at all ages. The results of the Allied Dunbar national fitness survey showed that one third of men and two thirds of women would find it difficult to sustain walking at a moderate pace (about 3 mph up a 5% slope). The survey showed that people's rates of participation in active sports and exercise are low. About one out of every six people is sedentary and reported no activities whatsoever of a duration and intensity likely to benefit his or her health.

Benefits for disabled and elderly people

In general, people who are old and people with a disability are particularly prone to the deleterious effects of inactivity. Any illness or transient incapacity accelerates the deterioration. The vicious cycle of inactivity leading to deterioration and progressive loss of fitness and capacities occurs rapidly and reflects closely the time scale of the vascular and biochemical deterioration in unused muscles. For these reasons rehabilitation must always be active and enthusiastic and inactivity must not be accepted as normal.

Exercise offers important benefits to elderly people, enabling them to maintain a reasonable degree of fitness for the tasks of daily living, reducing handicap, and helping to avoid or delay the necessity for institutional care. Because exercise increases energy expenditure it tends to increase the overall dietary intake, including the intake of substances which occur in small amounts. Thus the minimal requirement of elderly people for vitamins is more likely to be met. Regular physical movement can play a part in avoiding constipation and associated flatulence.

Exercise to improve muscle strength when successful brings confidence in negotiating steps and other barriers. Some elderly people with rheumatoid arthritis and others with muscular dystrophy report an increased freedom: they can to go out of the house and travel independently on public transport. People with rheumatoid arthritis may return to work after previously giving up their jobs because of their health. Physically active wheelchair users have a lower rate of absence from work and fewer admissions to hospital than inactive colleagues. Both motor skills and the speed at which manual work is performed improve in people with intellectual impairment.

In some conditions symptoms are ameliorated during exercise programmes. Admittedly, exercise will never replace function lost through impairment, but the evidence suggests that people with rheumatoid arthritis experience a decrease in the number of painful or swollen joints and the degree of pain and swelling. Consequent conditions and further deterioration may be prevented, delayed, or reduced by regular exercise. Joint contractures are prevented in children who walk rather than use a wheelchair. Exercise in the upright position reduces calcium loss after a spinal cord injury. Wheelchair athletes have fewer pressure sores and kidney complications than sedentary wheelchair users. Children with cystic fibrosis who are active have fewer respiratory infections than those who are not.

Who needs advice about exercise?

Cycling with the family is one enjoyable way to exercise

Almost all those over 50, however sedentary or whatever their health problem, can benefit from physical activity provided that progress is slow and cautious

Most people do not regularly take exercise during leisure time or at work sufficient to benefit their health; the degree of physical activity is low. To protect their cardiovascular health and function a large proportion of the population must be motivated to abandon the sedentary lifestyle.

Ideas are needed. We know that people will improve if they take moderate rhythmic exercise regularly, say, five times each week, choosing an activity which requires the use of most of the large muscles of the body—for example, brisk walking or swimming. To be effective the exercise must be continued for progressively longer week by week until it can be maintained for at least 30 minutes continuously. Other approaches may be effective and better suited to current patterns of daily life. Generally, the exercise taken should increase in intensity by small stages, each stage taking 8-10 weeks. This slow progression is particularly important for elderly or unfit people. The long term aim is, in general, to ensure that as many people as possible can at least walk a mile or more briskly on level ground.

The potential health gain from winning these changes in lifestyle is enormous.

P H Fentem is the Stroke Association professor of stroke medicine at the University of Nottingham.

The ABC of Sports Medicine has been edited by Greg McLatchie, visiting professor of sports medicine and surgical sciences, University of Sunderland, consultant surgeon, Hartlepool General Hospital, and director of the National Sports Medicine Institute, London. The section on physical and physiological aspects of performance has been edited in conjunction with Clyde Williams, professor of sport and exercise science, University of Loughborough.

OBITUARY

M L Formby

M L FORMBY

CBE, TD, FRCS

In his heyday Myles Landseer Formby was a leading ear, nose, and throat surgeon. A generous host, particularly to visiting Australian sportsmen, he enjoyed a wide circle of medical friends, being a genial and gregarious man. He was a benefactor to several medical causes, including the Royal Society of Medicine.

He came to England from Australia as a Rhodes scholar and in 1928, at Magdalen College, met Arthur (later Lord) Porritt; their friendship ended only with their deaths within a few days of one another. Myles was a lacrosse player and captained the university team—as recently, to his great pleasure, did his granddaughter—but his enthusiasm extended to many sports: as an oarsman he was a member of the Leander Club, while as a horseman he succeeded, as a brash Australian newcomer on a hired horse, in outjumping the foxhunting gentry of the Middlesex Yeomanry.

Having been appointed to the staff of University College Hospital in 1934, he returned there after the war and built a considerable private practice. Although he gave good service to his hospital, his disapproval of the NHS as a system led him to decline to take any salary from it. He played a full part in professional affairs.

In 1931 he married Dorothy, and they had a son and a daughter; this marriage was dissolved in 1952. Twenty two years later, in retirement, he married Phyllis, and they lived quietly in West Sussex. Phyllis died in 1986.—DAVID INNES WILLIAMS

Myles Landseer Formby, who had been an ear, nose, and throat surgeon at University College Hospital and the Royal Masonic Hospital, died 20 January aged 92. Born Australia; studied medicine at Adelaide University (MB, BS 1924), then was Rhodes scholar at Oxford University (BSc 1928). Appointed to University College Hospital 1934. During war served in army in India, Middle East, and Europe, becoming a brigadier. Continued as civilian consultant ear, nose, and throat surgeon to army. Awarded CBE 1962. Served as member of council of Royal College of Surgeons, president of section of otology at Royal Society of Medicine, and president of British Association of Otolaryngologists.

F R BETTLEY

TD, MD, FRCP

At a time when a London teaching hospital consultant might drive around in a Rolls-Royce Francis Ray Bettley did not use his but preferred to use a powerful motorbike. He was an elegant man with white hair and striking blue eyes, and he had great elegance of mind. This was shown in his wide education and reading and in the originality with which he carried out his research, for which he often made his own apparatus. He was brilliant at thinking out experiments, which were directly connected with or never too far from clinical dermatology.

Francis was a true intellectual; he was also, if need be, a cook, and he was a keen gardener. As a student he had designed hats and dresses to make money, and he had a good eye for interior design and furnishing. He was an accomplished painter and sculptor. He was very much the complete man but, at the same time, a very private one.

He had been the editor of the *British Journal of Dermatology* and had redesigned its cover. As president of the British Association of Dermatology he arranged an exceptionally fine annual meeting. After his retirement from a busy life in consultant practice and teaching he continued as a consultant dermatologist to the army in Germany.

Working for him was a joy because he was always encouraging and original, and in his ideas he was